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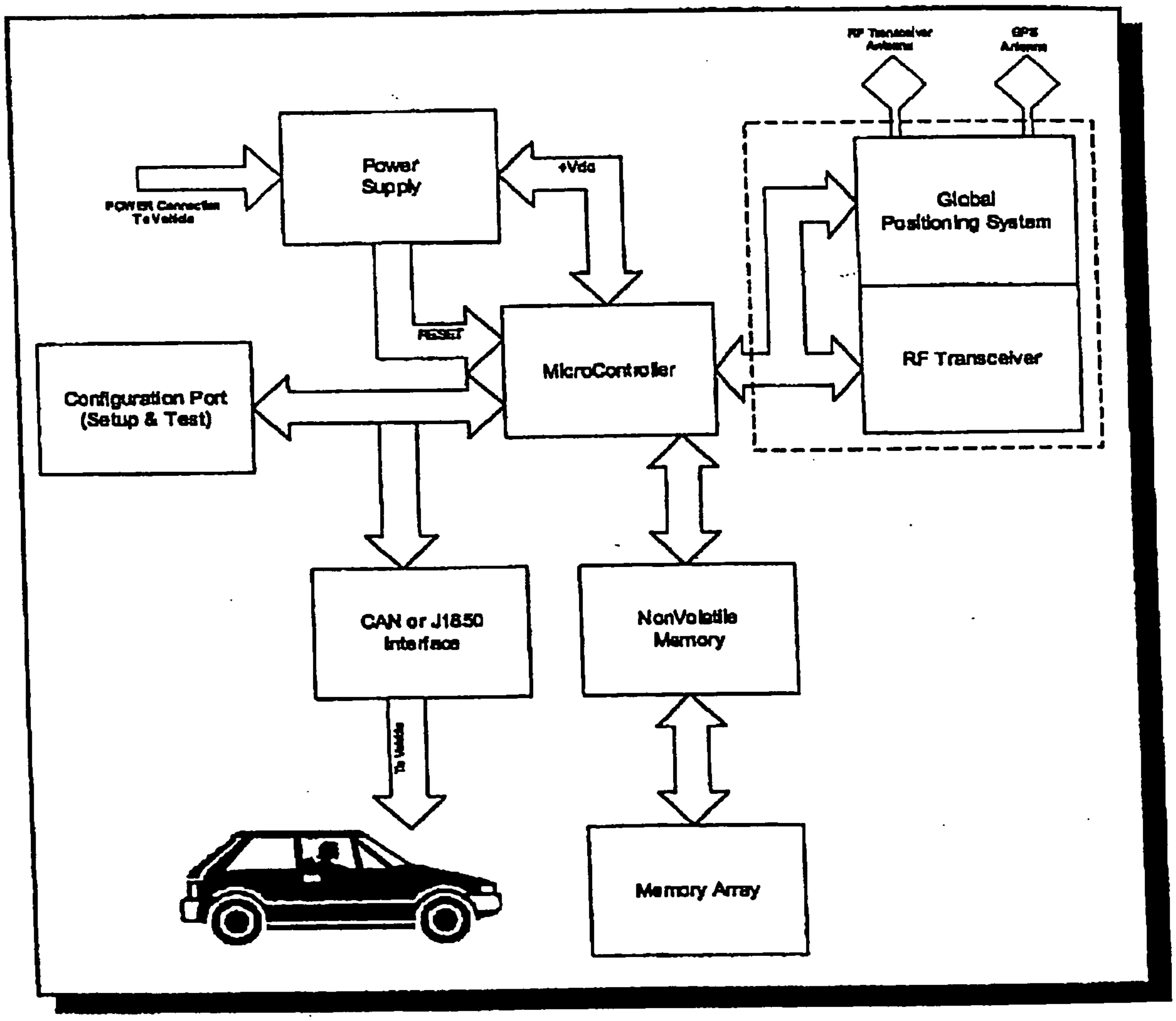
(54) **DISPOSITIF DE LOCALISATION DE VEHICULE**

(54) **VEHICLE LOCATING DEVICE**



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VEHICLE LOCATING DEVICE

Field of the Invention

The present invention relates to a system, (Vehicle Locating Device, (VLD)), that when installed and set-up in a vehicle, has the capability of electronically determining and reporting its geographical position (fix) and current status. The position fix is determined using a Global Positioning System (GPS) Receiver module. Additionally there is a back up redundant magnetic compass system that complements the GPS data in the event the GPS satellites signal become obstructed. The reporting function is preferably via a separate radio frequency RF-Modem transceiver. The main role of the system is that of a "Passive Vehicle Locator", (PVL) device and the additional role being a "Passive Collision Notification", (PCN) collision detection system. A reporting station or monitoring service receives and collects this data, and notifies the appropriate services if it is determined that the vehicle has been stolen or involved in a collision.

The details concerning the reporting station / message service is considered outside the scope of this invention as it represents third party operation of a GPS system, other than the receipt and processing of positional data.

Background of the Invention

A dramatic increase in vehicle theft, (*automobiles, snowmobiles, boats, aeroplanes, etc.*), for vehicle or parts resale has lead to an increase in demand by owners, police and insurance carriers for a measure to track and recover the stolen property. It is the intention of the applicant to provide the market with a tool to help aid in the recovery of stolen vehicles.

By means of a selected RF system transceiver from several radio frequency (RF) technology systems and a small system controller in the vehicle a watchful eye can be kept on ones' property through a monitoring service centre. Although it is not

the design intent of the system to prevent the theft of the vehicle, measures are built into the system to prevent the vehicle from starting where possible. The present system will not prevent the theft of a vehicle if it is with engine running. The system will communicate the vehicle's location and particulars to the monitoring service at the request of the monitoring service or when triggered by the in-vehicle system. The monitoring service can then notify the appropriate authorities.

The system operates as a total passive system to the user, with *"no user requirements"*. The primary function of the system is to continuously derive position fixes from the GPS receiver and compliment any magnetic compass system while the vehicle is operating and in the run mode and periodically when the vehicle is off. The fix obtained from the GPS receiver and compass is used by the system in the event of vehicle theft. The vehicle data is transmitted from the vehicle via a lo-VHF transceiver *(RF-Modem uplink to a LEOS)* system in one application of the system. This signal is then relayed from the LEOS to a Ground Earth Station (GES). The GES redirects the signal containing data to a designated monitoring service. The GPS and magnetic compass data collected by the in-vehicle system is temporarily stored to scratch pad memory and is routinely updated.

The key feature/function of the system is that of a collision and rate of movement detection system. By means of an onboard two axis accelerometer, shock and vibration data is continuously read while the vehicle is in the run mode and periodically when the vehicle is at rest. The system compares this data to programmed limits and acts accordingly when required. The system will communicate the collision ***"g" Force*** details to the monitoring service centre as well as the last fix.

System Function.

Locating and recovering a distressed vehicle is an obviously important factor in saving accident victims' lives and property. The ability to shave minutes or

seconds off the response time to an automobile accident is crucial when lives are in jeopardy. In some remote locations such as rural roads, a car accident may not be noticed until another person or automobile happens along. This could be hours or even days if for example an overturned car was off the road, buried in snow. This would also be particularly true if all the drivers and passengers were rendered unconscious by the impact, and or trapped inside wreckage.

A method of independently and instantly sending out a distress signal indicating the vehicles geographical location (fix) to emergency response authorities could serve to cut down on the delay time between the accident event and emergency services arrival. This is accomplished by:

- Eliminating and/or reducing the time between when the accident occurred and the time that a person finds the accident, (if no person was witness to the accident) or reports a missing person(s).
- Eliminating delay time from when a person finds the accident to when the person telephones the emergency services.
- Eliminating the possibility that a emergency response unit is dispatched, whilst a closer unit is unaware or not dispatched to the call.
- Minimizing the time used by the emergency services in locating the actual accident spot. In many rural roads the area is not well identified, and a stranger to the area reporting an accident report may not be able to effectively communicate the location.
- Automatic system initiates communications seconds after the accident, instead of relying on a person to decide to call. Any person immediately on the scene can concentrate on possibly removing the victims to a safe location, especially if the victim is in further danger, i.e. fire, drowning, cold, etc.

The relaying of the vehicles fix may also be utilized in locating vehicles that have been stolen or hijacked. Insurance companies and law enforcement agencies

welcome this aid in locating stolen property. If a system is able to determine if the vehicle has been stolen and report the occurrence and location at routine time intervals, the vehicle could more easily be located and recovered. While this mode would be less time sensitive than the accident location, it may happen that innocent persons may be in the car (kidnapped), thus the expedient interception and recovery of those vehicles is as critical as that of the location of accident vehicles.

A module, able to automatically perform this function independent of any user interaction, would be an attractive feature to many people. People whose occupations cause them to drive long distances and/or those who find themselves driving extensively outside of urban centres would be among those interested in fitting this type of equipment.

The main function of the VLD is to relay data pertaining to a disabled vehicle's geographical fix via low orbit satellite communications networks to ground based fixed relay stations. This communication is initiated by one or more specific sensor input activations. The activation of one of these sensors is related to very specific events, i.e. very high rates of deceleration, sustained negative forces in X, Y or Z axis or vehicle rollover, airbag deployment.

Brief Description of the Drawings

In drawings that illustrate the present invention by way of Example:

Figure 1 is a block diagram of the system of the present invention;

Figure 2 is a diagram illustrating the intersection of two satellite range spheres;

Figure 3 is a diagram illustrating the intersection of three satellite range spheres;

Figure 4 is a graph illustrating a GPS fix sampling rate algorithm; and

Figure 5 is a ULD block circuit diagram.

Description

The Vehicle Locating Device or VLD is an integrated assembly consisting of three minor components and/or subsystems contained to a rigid housing moulded of automotive grade plastics and die cast metals specific for the application. The complete system includes;

- Main Multifunction Control Module,
- Custom wire harness assembly,
- Rechargeable battery pack,
- GPS receiver,
- Lo-VHF transceiver, (RF-Modem),
- System antennas.

The two RF subsystems and antennae are of existing technology, registered to their respective companies and may be patented by those respective companies accordingly.

VLD Module.

Main Multifunction Control Module. (MCM)

The multifunction control module, (MCM), is the primary control element, and all features and system functions are controlled by this module. The MCM contains a two axis accelerometer type sensor, a magnetic compass, a serial communication controller, a power regulator and battery control system, a non-volatile memory array and peripheral interface circuits. The core microprocessor has the built in feature of a flash upgrade-able memory.

The flash upgrade-able memory allows updates to the operating system software contained within the core microprocessor. It is updated through a simple instrumentation hook-up via a serial communication port. There is no need of an expensive module replacement as would be the case for masked embedded microprocessor based systems.

The MCM serves as the system motherboard for the entire system and allows the placement and connection of the two remaining Radio Frequency (RF) subsystems and the connection of the rechargeable backup battery. The system is connected through to various points of the vehicle by means of a custom wire harness assembly connected via the right angle header, J1, *(part of motherboard assembly).*

The entire MCM is conformal coated with a high grade encapsulant type material reducing the effects and influence of environmental conditions, e.g.: dust, humidity, oil, grease and water.

Global Positioning System, (GPS) Receiver.

The global positioning receiver is a minimum of an eight (8) channel receiver. The GPS receiver is an integrated assembly, the module is installed and connected through to the MCM and is held in place by mechanical stand-off fasteners and a vertical system connector.

The GPS Receiver preferred for the purposes of this system definition is that of a subsidiary company to Magellan Corporation. *Technical Specifications pertaining the GPS Receiver are provided by ` Magellan for the GPS 8A series product.*

Note: Non-differential GPS Receiver, standard fix accuracy, ± 100 metres, 95% of the time. (± 0° 00.053996' of arc of a degree of longitude at L 0° 00.0' N). Fix update: 1 to 99 sec, user selectable, *(note: receiver requires active antenna).*

The active GPS antenna is connected to the GPS receiver. The GPS receiver supplies the necessary power to the antennae system. *Technical Specifications pertaining to the GPS Active Antennae are model dependant.*

Magnetic Two Axis Compass.

The magnetic two axis compass monitors both X & Y directions relative to the vehicle with an overall accuracy of 3%. The purpose of the compass is to compliment the onboard GPS receiver system. The compass provides the host controller updates on direction on demand. In the event GPS data and or signals from the GPS satellite array is lost or skewed the compass provides the back up direction data required to allow the system to calculate from the last valid GPS almanac data sets current direction and speed. In the event of theft the GPS antenna might be shielded or covered over by the would be perpetrator not knowing of the existence of compass system or a valid system failure.

RF-Modem, Lo-Vhf Transceiver.

The Lo-VHF transceiver is a bi-directional digital RF-Modem. The modem operates as similar to IEEE specification(s) RS232-C and is limited to a data baud rate of 2,400 bps in the up-link direction and 4,800 bps in the downlink. The RF-Modem requires a separate antenna assembly commonly available.

The transceiver is an integrated assembly, the module is installed and connected through to the MCM via mechanical stand-off fasteners and a system connector.

The transceiver selected for the purposes of this system definition is that of a subsidiary company to Magellan Corporation. *Technical Specifications pertaining the RF-Modem Transceiver are provided by Orbcomm Magellan for the OM 200 series product*.

Custom Wire Harness Assembly.

The wire harness assembly consists of system automotive grade connectors and is fabricated using automotive electrical wiring and techniques. The gauge and

rating of the wiring is as per standard automotive specifications and practices for use in passenger compartment and trunk deck.

The individual wires of the harness are colour coded to insure ease of installation and identification, thus reducing risk of potential errors.

Summary of Features.

- Motherboard design, flexibility of add-on module types,
- Motherboard contains key system circuitry,
- Integrated two (2) axis accelerometer used for impact/collision detection,
- Integrated two (2) axis magnetic compass system,
- Integrated power supply and *"Battery Run Down Protection"*
- Integrated battery charge control system,
- Standard automotive battery voltage range, (9-16 Vdc.),
- Low standby current requirements,
- Environmental conditions protected assemblies,
- Electrical stress protected assemblies,
- Ease of placement and installation to vehicle,
- Extensive onboard system diagnostics,
- Custom wire harness, matched to vehicle manufacturer,
- Automotive grade custom wire harness assembly,
- Flash memory capabilities type microprocessor, ease of OS update software,
- Vehicle communication bus compatibility *(where possible),* J1850 or CAN 2.0b,
- System connects and monitors installed alarm system status,
- System operates in a total passive mode of operation,
- Simplified system set-up and registration with monitoring service, completely automated and passive to user and technician,
- Auxiliary GPS signal output.
- "Set-up & Test" serial communication port,

- RF Transceiver flexibility and system design, the system can operate with conventional cellular systems as well with LEO type transceivers.

** J1850 & CAN 2.0b are in-vehicle structured bus protocol systems and respective specifications. Each manufacturer will have their own unique set of instructions and function per instruction list. Additionally not all vehicles will be equipped with systems as such, connection to other altemate onboard systems will be required.*

Detailed System Description & Operation.

Main Multifunction Control Module. (MCM)

The system comprises four key elements to form the entire system. The main multifunction control module (MCM) forms the nucleus of the system and contains all operating system parameters of features/functions and the system non-volatile memory storage system and the two axis impact detection accelerometers and the compliment two axis magnetic compass. The remaining two systems are the RF-Modem transceiver that supports the two way communication requirement with the LEO system in one application of the system. The GPS receiver and magnetic compass requirement is to provide on demand by the MCM position data of which is from time to time updated and stored to non-volatile memory. Three temporary buffers contained to the core microprocessor is utilized for temporary storage containing the position data and updated in a FIFO manner, (First In, First Out).

The system is completely passive to the user of the vehicle the system is installed. Upon completion of the installation and initialization by a trained technician the system is ready for use. The system is self contained with little to no serviceable parts. Failure of the MCM will require replacement of the module assembly.

Included to the systems operational modes is an extensive collection of system diagnostics. Should the system encounter any system problems a output signal containing the problem data will be transmitted to the reporting station or

monitoring service (RS/MS) for further action. The action or protocol the RS/MS are to follow are dependant on the seriousness of the reported problem which dictate the final action. A *"Priority List"*, available to the RS/MS describes the problem(s) or condition(s). The problem(s) or condition(s) are scaled by priority and/or severity accordingly.

Diagnostics, MCM (Basic).

Prove Out Cycle.

The "Prove Out Cycle", (POC) is an integral part of the normal system function and baseline diagnostics allowing for the verification of system integrity and operational worthiness. The POC is initiated at every key "ON" condition, regardless of engine crank cycle absence.

Continuous System Diagnostics.

Continuous system diagnostics and monitoring, the MCM continuously monitors all connected points through to the vehicle via the wiring harness and internal modules and systems contained within the MCM system including the RF-Modem and GPS assemblies.

Failure Detection Diagnostics.

The Failure detection Diagnostics mode triggers the system to seek help, either by means of communication with the RS/MS and by module mounted diagnostic light emitting diode (LED) indicator. The LED indicator will light solid when a system failure is present, service is required to rectify the condition.

Within the description of the FMEA (Failure Modes & Effects Analysis) tables there are accepted predictable failure mode conditions, these conditions can be deemed as catastrophic failures or conditions that could prevent the lighting of the system status LED and/or the communication via the RF-Modem through to the RS/MS. The conditions and failure modes are known calculated quantities.

Intermittent Problems. Intermittent Flags.

The system will and does from time to time experience *"Intermittent Conditions"* which are normal conditions and are an accepted series of conditions of which manifest themselves and later are not traceable or repeatable. These conditions are problematic in nature, the MCM is capable of dealing with common *(known intermittent quantities derived from the system Failure Mode and Effects Analysis (FMEA)),* under most conditions intermittent conditions or commonly referred to as intermittent flags (IF's) and are stored to the MCM's temporary memory and after a given travelled distance of 200 kilometres or fixed usage period of time dependent on the type of IF the flag(s) are erased. However the original problem code is stored to permanent memory for later history retrieval and perusal by either a technician or the MCM system.

Should an IF recur, *(repeated IF condition)* the history will be available from the MCM's non-volatile memory. After which and an election by the system will be carried out to transmit the conditions to the RS/MS at which time appropriate action and steps to rectify the problem and contact the user are initiated.

Vehicle Communication Area Network.

In-Vehicle technology supports multiple system level of communication between various dedicated system modules. Contained to the vehicle are a series of electronic dedicated controllers, these units share a common communication bus connecting all vehicle critical and non-critical functions. There are currently several methodologies to achieve this communication protocol and structure however, the most commonly used protocols are **CAN 2.0b** and **SAE-J1850.**

Integrated Two Axis Accelerometer.

Collision Detection.

The purpose of the integrated accelerometer is to support the Passive Collision Notification (PCN) function of the MCM. The two (2) axis accelerometer

continuously measures and monitors changes in X&Y and derived limited Z planes. In the event of a collision the system will assess the net impact ***"g" Force*** and forward the data in addition to other pertinent data to the RS/MS.

In those vehicles where the VLD is connected through to the in-vehicle communication area network data is obtained of a vehicle collision by means of the onboard Supplemental Restraint System (SRS) control module when the system engages the SRS air bag system. A duplication or redundancy is obvious, however, the detection systems being the integrated two axis accelerometer and the vehicles' own SRS "g" Force monitor provide differing levels of data acquisition and comparison.

Vehicle Rollover Detection.

The VLD discerns vehicle rollover utilizing data from the two axis accelerometer and the two axis magnetic compass. Rollover can also be detected by the acceleration with the two (2) axis mode of sensing. Normally, at rest, the accelerometer will experience a derived 1g in the Z axis. Normal driving and operation of the vehicle will not produce any less downward accelerations for any significant length of time. In the case of a rollover, the vehicle is expected to undergo a series of violent swings in all planes, the forces acting in the Z axis will be derived and indicative of the event. Thus the analytical software discerns a rollover signature, and starts the reporting process to the RS/MS.

Radio Frequency, (RF) Subsystems.

The VLD / MCM housing accommodates the two RF subsystems, being the RF-Modem and the GPS Receiver.

GPS Receiver Module.

The purpose of the GPS receiver of the MCM is to determine the geographical position (fix) in degrees latitude and longitude of present position. The

module receives signals from a series of geo-synchronous satellites orbiting in precise locations over the earth.

The GPS receiver calculates the range from the receiver to each satellite. Once the range to a satellite is determined, it follows that the receiver lies somewhere on a sphere with its radius equal to the calculated range. The position of the satellite is the centre of that sphere. If the range to a second satellite is found, a second sphere can be superimposed around that satellite. The receiver position now lies somewhere on the circle where the two spheres intersect (see Figure 2).

This, *(to be noted),* is different than the circle of position concept in standard navigation terms as this circle is oriented with the centre axis ends coinciding with the position of the two satellites rather than the circle of position with a radius = 90°-ho with its' axis oriented between a celestial body and the geographical position of that body. With a third satellite, the sphere intercepting the circle results in two common points, the location is reduced to two points (see Figure 3). A fourth satellite therefore fixes the altitude of the receiver.

To determine the range from the satellite, the receiver requires two variables: elapse time and speed. A continuous radio signal is sent out by the satellites and is picked up by the receiver which multiplies the speed of the signal by the time it took the signal to travel from the satellite to the receiver. The signal packet transmitted by the satellite is divided into a random sequence, each division being different from each other, called pseudo-random code (PRC), the random sequence is repeated continuously. The GPS receiver is programmed with this sequence and generates it internally, therefore, satellites and the receivers must be synchronized.

All GPS satellites have atomic clocks, the receiver extracts the satellite's transmission and compares the incoming signal to its own internal signal. A comparison of how much the satellite signal is lagging gives the travel elapse time,

multiplication of this by the speed factor: c=2.997 924 58 x 108 m*s-1, the official WGS-84 speed of light, determines the distance or range to that satellite.

GPS Data Error.

The spherical radii of the satellite signals are determined for the three or four different satellites. With the PRC, the satellite transmits its orbital position data or almanac. The GPS constellation is monitored by the Master Control Station, (MCS) at Schriever Air Force Base. Using data collected by five monitor stations distributed around the globe, the MCS assesses the GPS performance every 15 minutes by conducting tolerance and validation checks of the measured pseudo ranges using a filter error management process.

Several brands of receivers have the capability to track as many as twelve satellites (channels) simultaneously, the advantage being that it can select two or three sets of satellites that have the best "cut" or azimuth angle characteristics as well as healthy almanac data. Horizontal Dilution of Precision (HDOP) is caused by a poor satellite set angle geometry. If the GPS receiver is using satellites in the same area of the sky as opposed to being distributed across the horizon, the location of the receiver becomes increasingly uncertain. Thus a good geometric position, or cut between each of the satellites around the earth's horizon would be 120°.

With the advent of the Selective Availability (SA) deactivated by the US Government allows for GPS derived data accuracy improvement. Thus the standard precision that can be expected from an uncorrected GPS receiver is ± 10 metres 95% of the time. For the purposes of the VLD module, this is considered the working error of the systems precision and will suffice for the requirement of accuracy.

GPS Sampling Rate.

The MCM routinely accesses the GPS data and stores it to memory. There are always three sets of data available for comparison. The rate at which the data is

accessed is fixed however, the distance travelled of the vehicle at higher velocity is greater then that of a slower moving vehicle.

The speed of the vehicle can be determined any number of ways, by GPS sampling, or from the vehicles own data bus, by external sensor or takeoff from the vehicle's instrumentation. The sampling rate or "Update Factor" relationship is illustrated in Figure 4.

If the VLD experiences an acceleration and/or deceleration greater than a pre-set threshold (approximately 5 g's), the system will immediately try to acquire a current fix from the GPS satellite array and store this latest data to the non-volatile memory. In such a case the VLD is designed to aid in collision location. In addition to the location and time, the VLD can be configured and programmed to record the previous speed, time, course (direction) and other pertinent parameters over a pre-set period of time.

Note: The technique and technology described supporting the activity of multi-point data acquisition is patented and registered to Ardtech Technologies Inc., and is known as the "Data Collection Waterfall Memory System" (DCWMS) and is part of a separate system. This technology allows for the capturing and storing of ten (ten) seconds of data prior to an event.

The most recent fix is temporarily stored to the Non-Volatile Memory (NVM) array as Fix 1, indexing the preceding fix to Fix 2, the previous fix before that one to Fix 3 and so on, commonly referred to as a "FIFO" operation explained earlier to this document. The NVM has the capacity to record three fixes, and one static set of data utilized by the micro-controller.

Additionally, the MCM continuously via the magnetic compass estimates a Dead Reckoning (DR) position based on last known good data from the GPS

receiver and current speed and bearing. This DR and GPS data is constantly updated and continuously calculated and in the event the GPS receiver was unable to acquire a usable fix, e.g.: the antenna was shielded from satellites, or the unit suffered a power interruption and was performing a (warm) boot at the time DR would be available to provide a running DR.

__Custom Wire Harness,__

The custom wire harness is required to interconnect the various sensors (if any) and vehicle connection points to the MCM, as well as derive supply power from the vehicle, (+12Vdc and Gnd.). It will also include antennae required for the GPS and RF-Modem transceiver system for the selected technology.

The main wire harness is an assembly of specialized automotive grade wire and connectors. A primary wire harness plugs into the MCM unit, and is terminated with various connectors. Various extension harnesses allow connection of the primary wire harness to optional remote sensors, power and ignition pickup points.

The antennae wires will also emanate from the MCM unit. Special coaxial type connectors and wire are utilized.

__Brake Input,__

Derived from the vehicle system bus, the brake input *__can__* be used in conjunction with the two axis accelerometer system for the purposes of data collection for the Detected Collision Waterfall Memory System, (DCWMS). The data stored in the memory would indicate speed at which the brakes were applied, rate of deceleration, speed of impact, etc. *This input signal can also be derived from the brake pedal switch.*

Vehicle Speed Sensor

Derived from the vehicle system bus and can be included as an optional item to those vehicles that are not equipped with automated systems. The speed input signal is used for such things as the look ahead algorithms, accident reconstruction.

The look ahead algorithm is incorporated to predict where the vehicle should be within a certain time period, much like a Dead Reckoning (DR) position. Thus if the GPS signal is blocked or it was not capable of delivering a good fix, the VLD in conjunction with the magnetic compass would *"Predict"* the next position, based on its last known fix, speed and bearing and compass data. The technique for predicting the next position could be based on one of several techniques, such as cosine law or meridonal parts. It would be able to deliver a usable DR position this for only a short elapse time as change in bearing or altitude would not be compensated for. As soon as the GPS module is able to deliver a good fix, the DR position would be thrown out. Otherwise this data would be stored and relayed as part of the location data.

Rechargeable Battery and Charge System.

The MCM has a built in series of rechargeable battery cells, these cells require periodic conditioning and recharging. The cells are required to provide power to the VLD after a power interruption occurs. The amount of energy available from the cells from a full charge allows for up to two (1.5) hours of continuous usage before requiring a recharge.

The battery charger system is an intelligent battery charge control system. There are no user serviceable parts contained with the exception of battery replacement by a qualified technician.

The battery is contained to the MCM enclosure, the compartment section housing the battery is reinforced and sectioned away from other local circuitry.

Enclosure

The enclosure of the MCM contains the main circuit board and the plugged on daughter boards, (GPS receiver and the RF-Modem). The enclosure is a metal die cast moulded assembly for the bottom half with optional side inserts for various connector configurations.

The bottom half is characterized by the protrusion of several reinforced mounting tabs or feet and or various through holes for screw mounting to the vehicle. Moulded inside the bottom half is mounting bosses and guides for securing the circuit boards. Reinforcing ribs are also integral to the bottom half for stiffness and strength. The tray is designed to accommodate a layer of conformal coating and encapsulation.

The top cover is a simple aluminium stamped assembly and is affixed to the bottom half with a combination of metal screws.

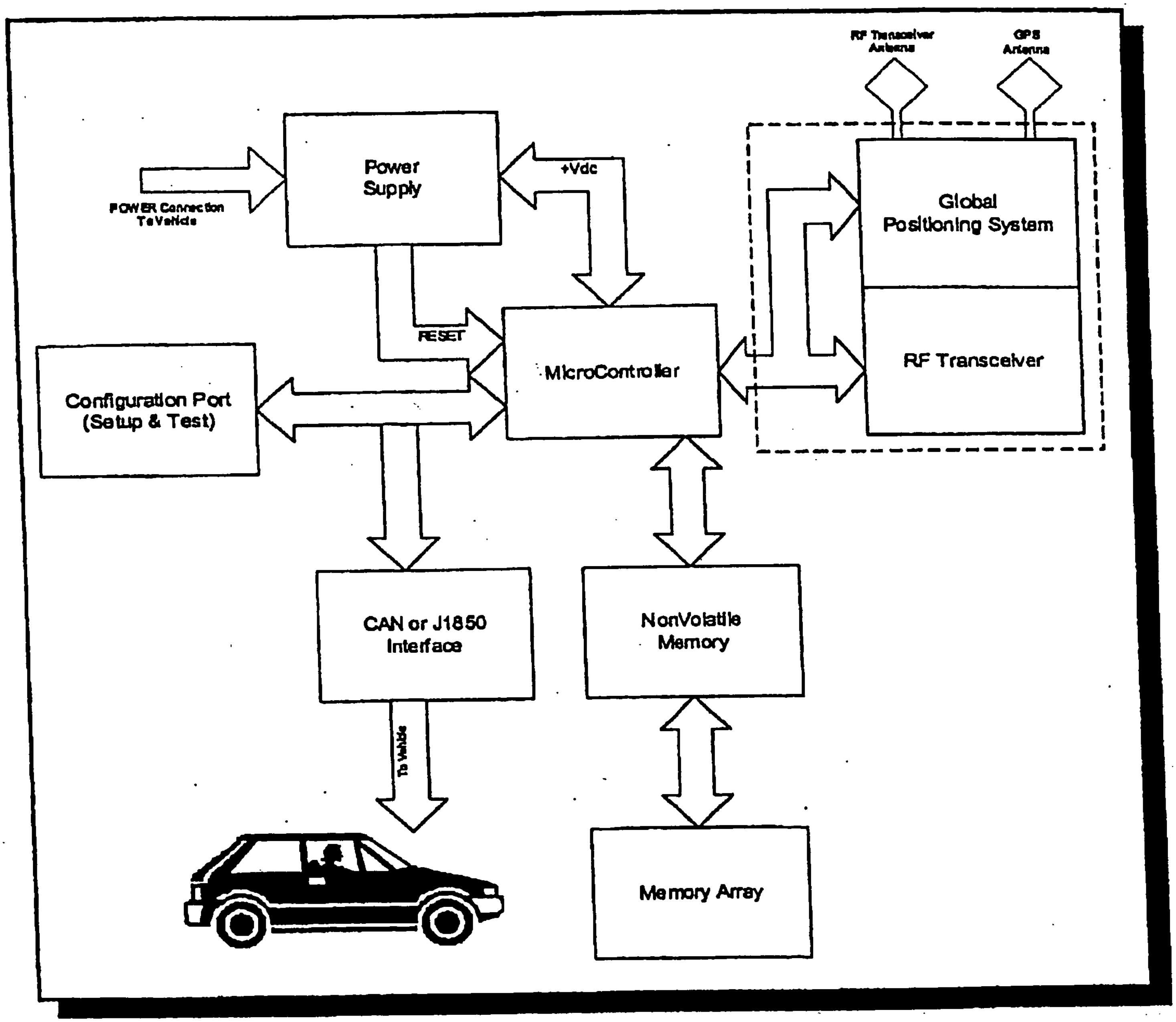

RF Transceiver Antenna
GPS Antenna
POWER Connection To Vehicle
Power Supply
+Vdc
Global Positioning System
RESET
Configuration Port (Setup & Test)
MicroController
RF Transceiver
CAN or J1850 Interface
NonVolatile Memory
To Vehicle
Memory Array

FIGURE 1

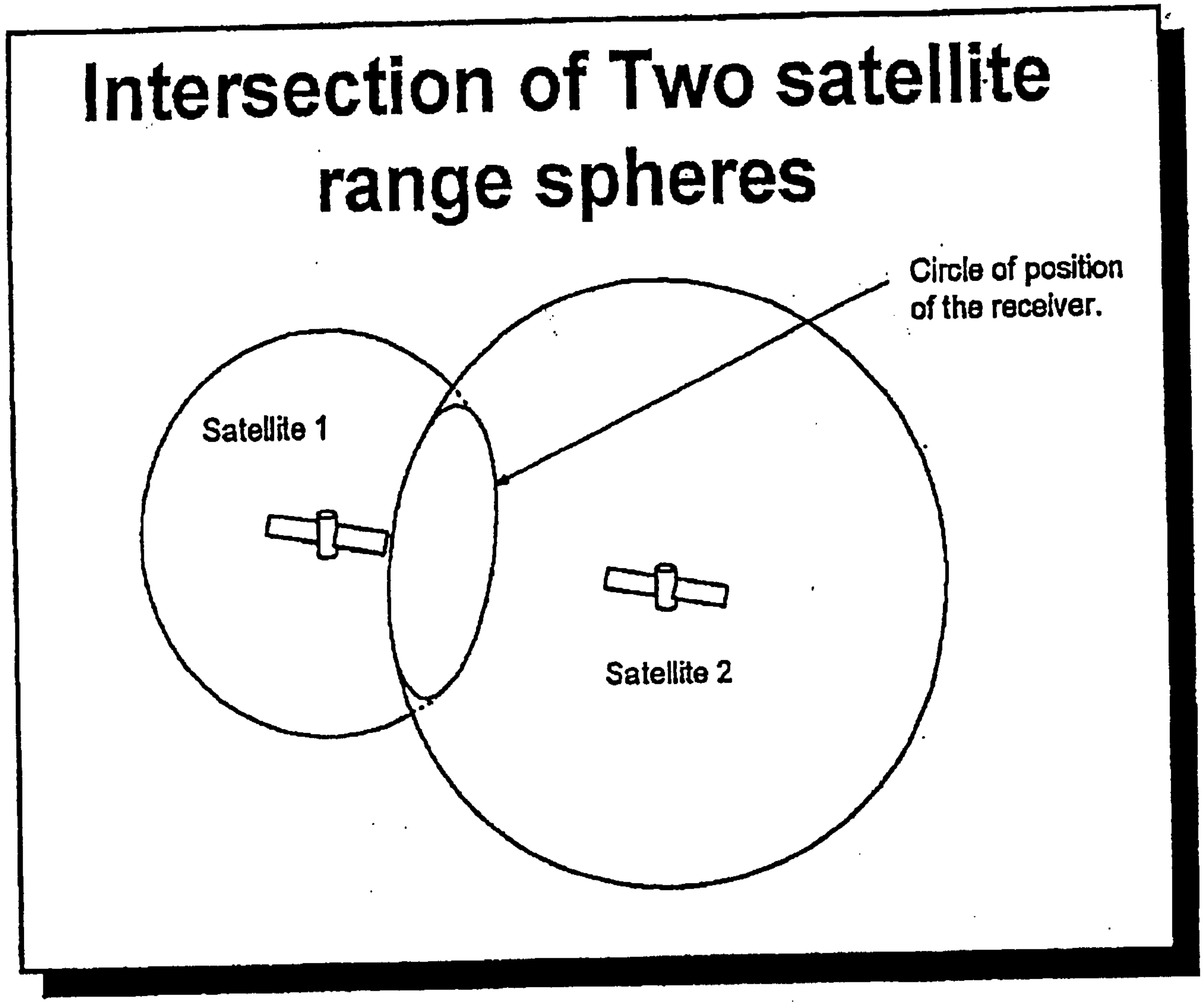

Intersection of Two satellite range spheres
Circle of position of the receiver.
Satellite 1
Satellite 2

FIGURE 2

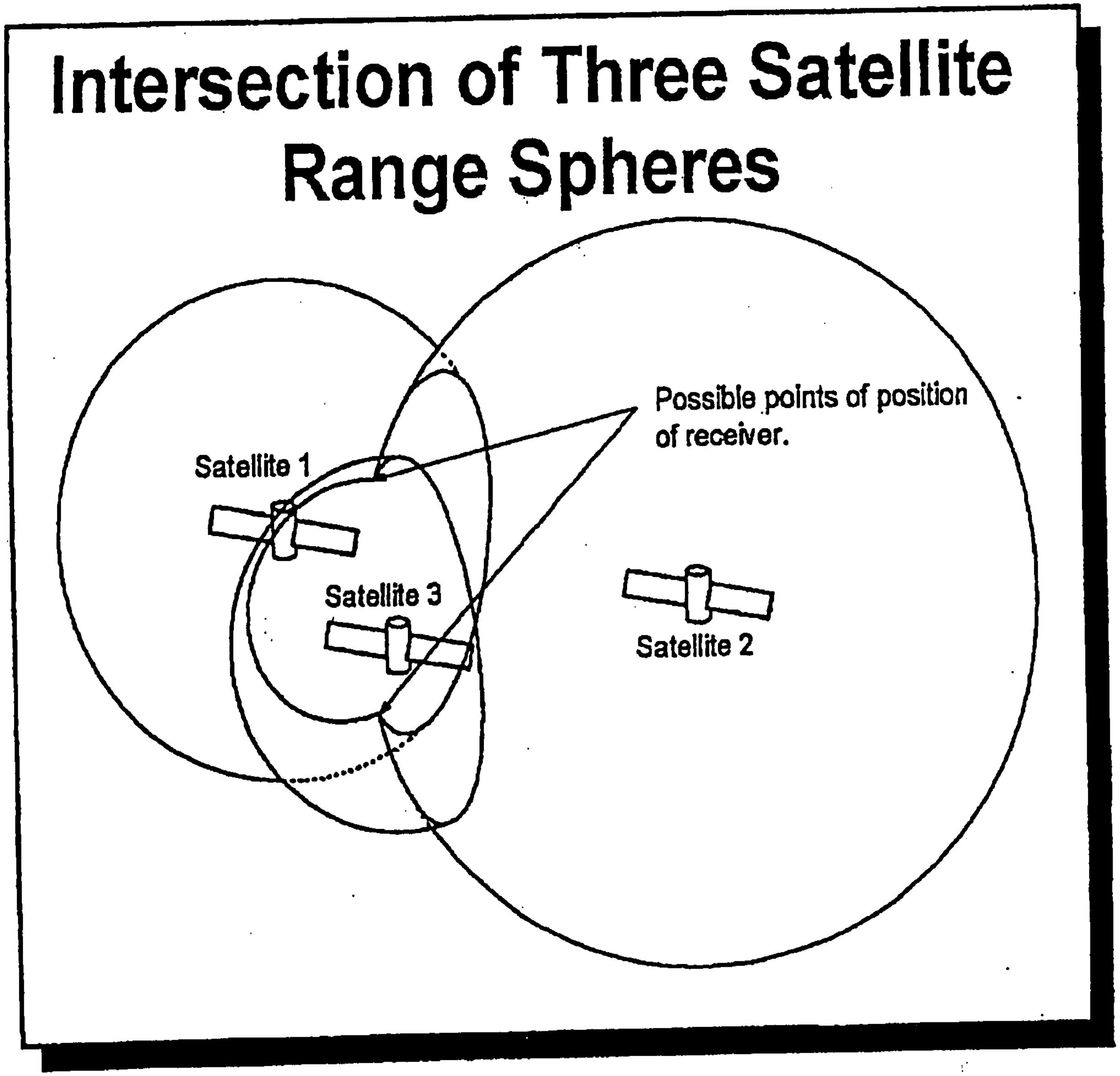
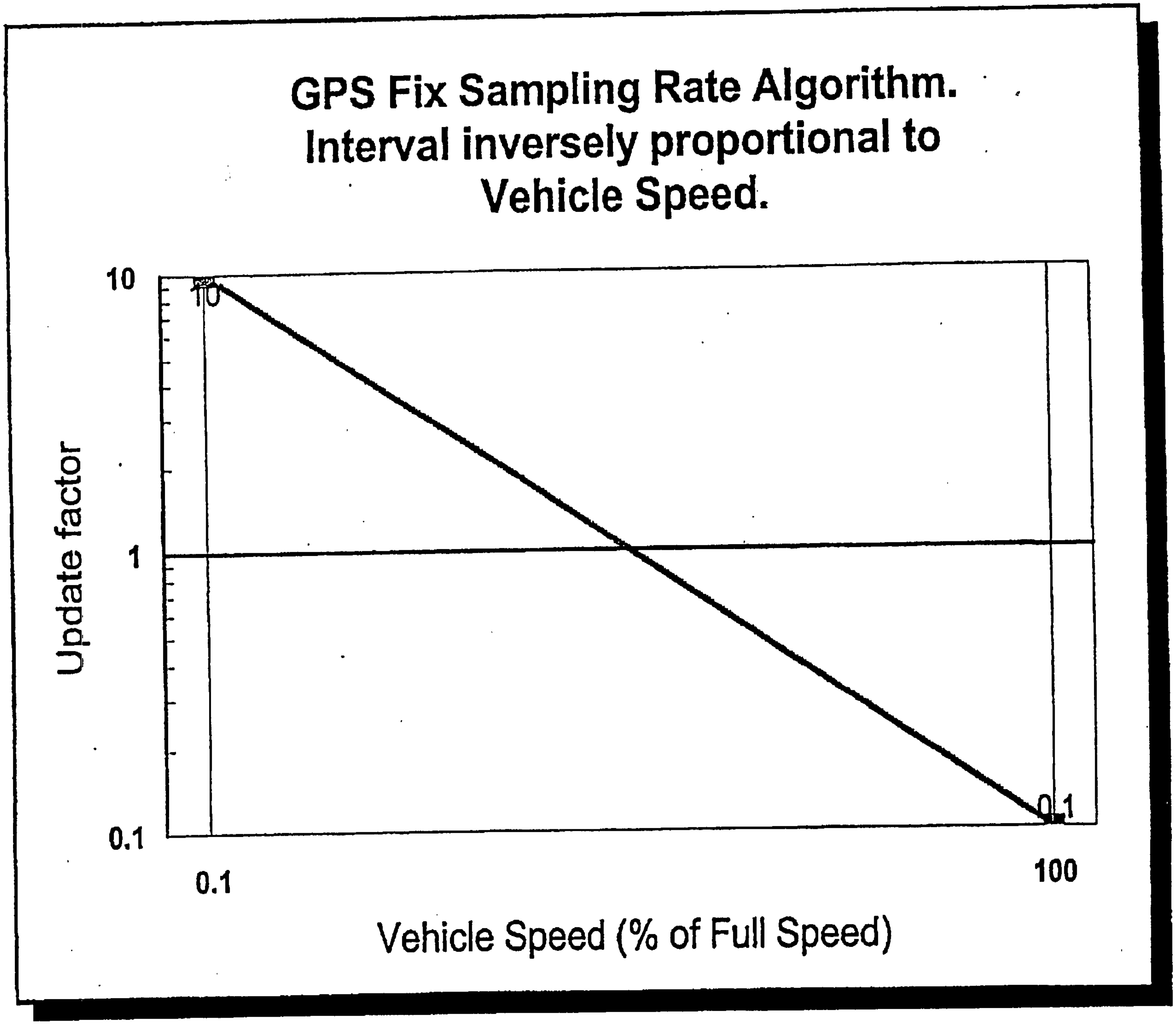

Intersection of Three Satellite Range Spheres
Possible points of position of receiver.
Satellite 1
Satellite 3
Satellite 2

FIGURE 3



GPS Fix Sampling Rate Algorithm.
Interval inversely proportional to
Vehicle Speed.
10
1
0.1
Update factor
10
0.1
0.1
100
Vehicle Speed (% of Full Speed)

FIGURE 4

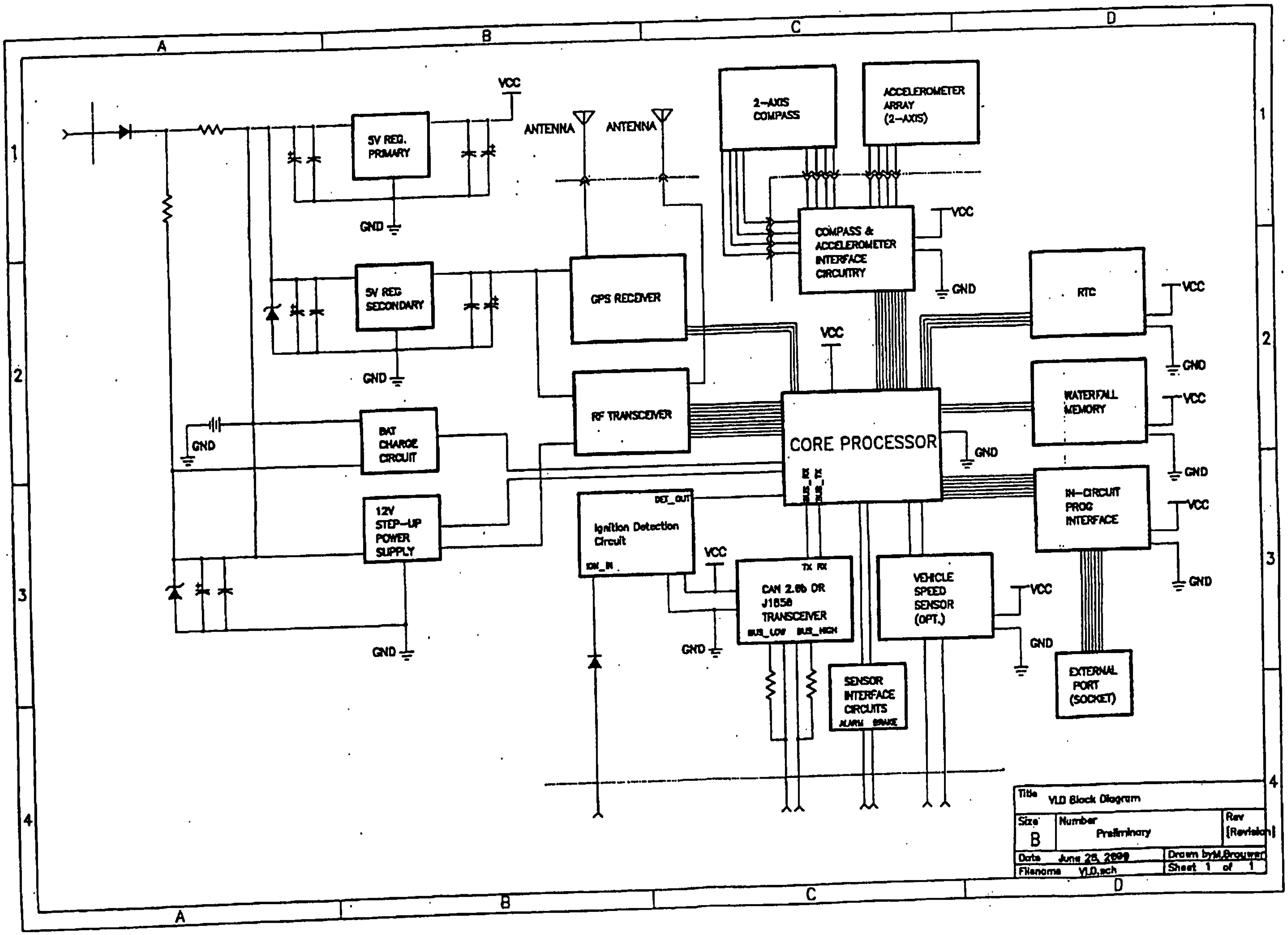

VCC
ANTENNA
ANTENNA
5V REG. PRIMARY
5V REG. SECONDARY
GND
BAT CHARGE CIRCUIT
12V STEP-UP POWER SUPPLY
GPS RECEIVER
RF TRANSCEIVER
Ignition Detection Circuit
DET_OUT
IGN_IN
2-AXIS COMPASS
ACCELEROMETER ARRAY (2-AXIS)
COMPASS & ACCELEROMETER INTERFACE CIRCUITRY
CORE PROCESSOR
TX RX
CAN 2.0b OR J1850 TRANSCEIVER
BUS_LOW BUS_HIGH
SENSOR INTERFACE CIRCUITS
ALARM BRAKE
VEHICLE SPEED SENSOR (OPT.)
RTC
WATERFALL MEMORY
IN-CIRCUIT PROG INTERFACE
EXTERNAL PORT (SOCKET)
Title VLD Block Diagram
Size B
Number Preliminary
Rev [Revision]
Date June 28, 2000
Drawn by M.Brouwer
Filename VLD.sch
Sheet 1 of 1

FIGURE 5